Implementation of the D'PEk_Hil for Early Detection of Preeclampsia and Clinical Recommendations in Pregnant Women

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ABSTRACT

Early detection and the management provide strategic role to decide therapies for mothers with high risk of preeclampsia and to prevent further complication. Expert-consulting system-based application could accelerate the early detection of preeclampsia and provides immediate expert feedbacks. This research and development attempted to implement D'PEk_Hil application for early detection and provide preeclampsia recommendation. This quasi-experimental design used posttest only design with non-equivalent control group. The subjects were 28 midwives grouped into intervention group to receive D'PEk_Hil application, consisting of 14 midwives; and control group to receive Mother-Child handbook, consisting of 14 midwives. The researchers analyzed the data with independent t-test. D'PEk_Hil application, observed in the intervention group, yieleded an immediate diagnose provision with 435,46 ± 25,809 (seconds) while the control group was with 608,11 ± 62,756 (seconds), (p-value of 0.01). The intervention group had a speed of providing recommendation for 444,46 ± 25,809 (seconds) while the control group was 695,25 ± 62,756 (seconds), (p-value of 0.000). The results revealed significant mean differences of diagnosis provision speed and in terms of providing recommendation based on the diagnoses between the groups. The D'PEk_Hill implementation could improve the time efficiency to early detect and provide therapy recommendaitons for preeclampsia mothers.

INTRODUCTION

Preeclampsia may occur due to hypertensive disorders, the pregnancy complications. This situation put both mother and fetus at high risks. Preeclampsia, a hypertensive disorder, may develop after 20-week gestation, characterized by high protein levels (Rana et al., 2019). This disorder may also impair placental factor and influence maternal kidney, liver, and brain function. A prolonged situation of preeclampsia without any accurate management may lead to tonic-clonic seizures (eclampsia) (Musyoka et al., 2019). According to the World Health

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Organization (WHO), major causes of maternal mortality worldwide include severe hemorrhage, infection, hypertension (preeclampsia), complications during childbirth, and unsafe abortion (Cresswell et al., 2025).

Preeclampsia significantly contributes to maternal and fetal morbidity and mortality, including intrauterine growth restriction, placental abruption, oligohydramnios, stillbirth, and fetal death (Chen et al., 2022). Scholars estimate the effects of preeclampsia, between 2% and 8%, of all pregnancies worldwide. Thus, preeclampsia becomes the leading cause of both maternal and perinatal morbidity and mortality (Vera-Ponce et al., 2025). Previous studies revealed the range of prevalence of preeclampsia between 1.8% and 16.7% in developing countries, while the prevalence in developed countries was only 0.4 (Mou et al., 2021). In Indonesia's setting, hypertensive disorders, as the attributed factor of maternal deaths, increased from 8% to 19% between 1990 and 2022 (Khan et al., 2022). This high mortality requires the immediate necessity to provide excellent prevention and preeclampsia management strategies (Aldika Akbar et al., 2025).

The efforts of lowering the preeclampsia rate may also include antenatal care, or ANC. This care is crucial and associated with preeclampsia (Tesfahun et al., 2023). (Gultom, 2024) also asserts that regular ANC visits improve the early detection of preeclampsia. This effort allows healthcare providers to routinely monitor blood pressure, assess symptoms starting from edema and headache, and perform urine tests to identify proteinuria (Gultom, 2024). Since every pregnancy carries a risk of complications, pregnant women should understand the risk factors and preventive measures related to preeclampsia. The effort to provide ANC-integrated early detection could prevent pregnancy-related illness and lower long-term health risks (Nurhayati, 2025).

Early detection applications for preeclampsia are needed to accelerate diagnosis and provide appropriate recommendations for pregnant women. Several studies have developed technologies to improve the early detection of preeclampsia. For example,

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a rule-based system (RBS) has demonstrated effectiveness in accelerating early detection and supporting healthcare professionals in clinical practice (Aini et al., 2019). Furthermore, an Android-based preeclampsia detection application was shown to facilitate faster diagnosis and provide appropriate therapeutic recommendations based on preeclampsia diagnosis and management guidelines(Simbolon et al., 2020).

The advances, on the other hand, still pose limitations, for example, the absence of human-in-the-loop feedback as the mechanism to provide direct expert consultation. Thus, expert feedback integrates specialist knowledge into the decision-making process and improves the certainty of clinical recommendations (Simbolon et al., 2020). According to the maternal and child health (MCH) handbook, early preeclampsia screening requires referral to a specialist when scoring identifies at least two moderate-risk factors (yellow category) or one high-risk factor (red category) (Aini et al., 2019). In addition, researchers should evaluate such applications using the Technology Acceptance Model (TAM) to assess users' acceptance of information systems (Simbolon et al., 2020).

Based on these issues, the researchers sought to extend previous work on the early detection of preeclampsia and recommendation systems for pregnant women through the D'PEk_Hil application. This study aims to determine whether the application can accelerate diagnosis, provide appropriate therapeutic recommendations, and connect users directly with experts. Ultimately, the application is expected to help prevent more severe complications of preeclampsia.

RESEARCH METHODS

This quasi-experimental design research used posttest only design with non-equivalent control group. The current research used two groups: the intervention group receiving D'PEk_Hil and the control group with maternal-child handbook. The application, D'PEk_Hil, is a developed product from the previous application. The latest features of the application, after the previous version, are: complemented

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with check-up data, the 17 preeclampsia risk factors based on Naitonal Guidelines for Medical Services of Indonesian Obstetrics and Gynecology Association and the 2020 Maternal-Child handbook; and the human-in-the loop role (HiTL). The utilization of this early application detection is online. Thus, users can input the data of pregnant mother check-ups and lead to diagnoses automatically.

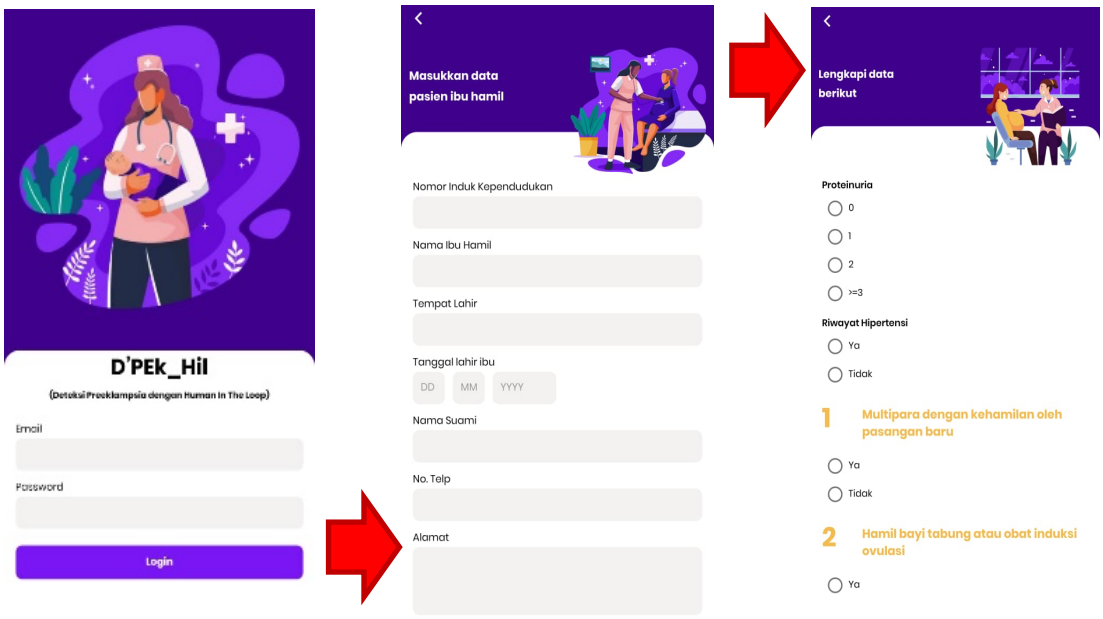

Figure 1
The D'PEk_Hil Display

The system provides therapy recommendation based on the guideline and diagnoses of the pregnant mothers automatically after users gained the diagnoses.

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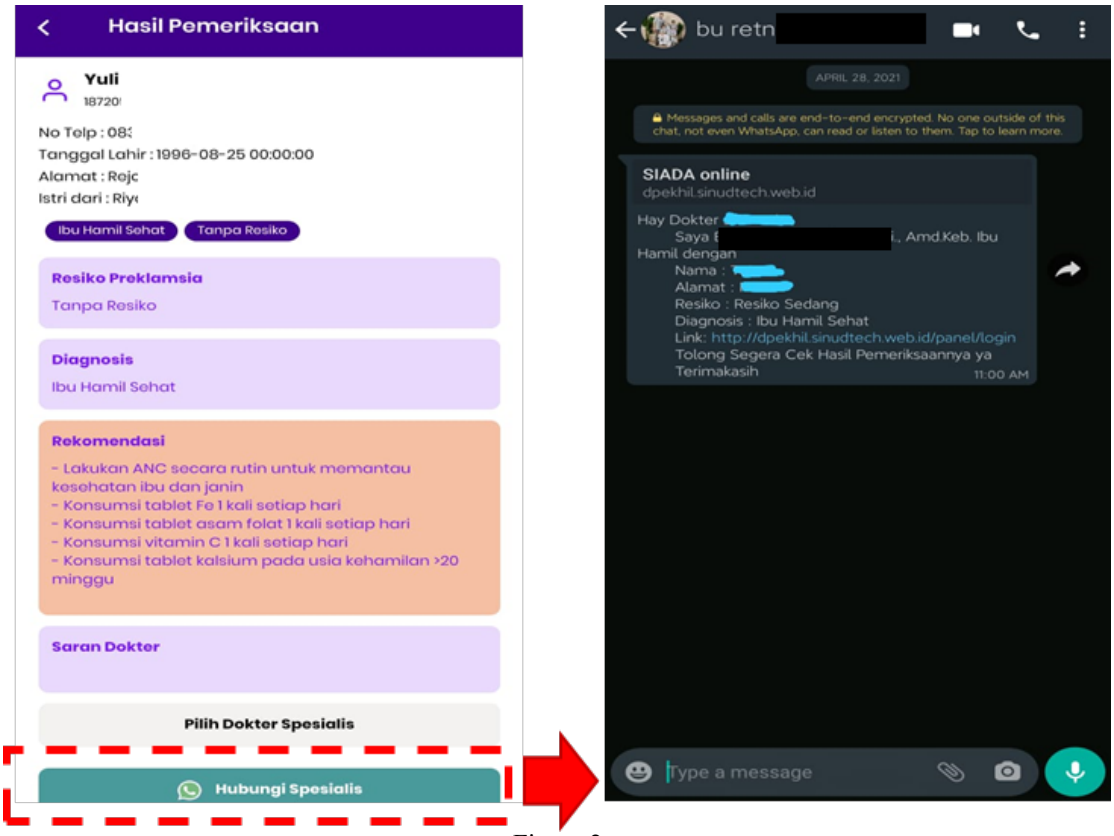

Figure 2
The Recommendation and Human in the Loop Features of D'PEk_Hil Application

This application also serves to provide expert consultation with a feature to directly connect healthcare providers and specialist physicians. This connection occurs through a human-in-the-loop, HiTL, mechanism. The given expert feedback allows specialists to examine the accuracy of the generated diagnoses and recommendations by application to reflect the pregnant woman's condition.

The researchers performed this research at Margorejo, Ganjar, Agung, and Tejo Agung community health centers in April 2021, in Metro City, Lampung. The researchers took 169 healthcare providers, the midwives, working in the city. The period of the research lasted over a year. The researchers determined the sample size with Slovin's formula, leading to 14 participants for each intervention and control group. The researchers employed purposive sampling and included midwives who held at least a three-year diploma, could operate and

use online applications, agreed to participate in the study, had received training on the D'PEk_Hil application, and owned a smartphone running Android version 2.0 or higher. The exclusion criteria included midwives who were unable to operate online applications and those who declined participation.

The researchers used several instruments for data collection. First, the researchers used a stopwatch to measure the speed of preeclampsia diagnosis and recommendation provision. In this mechanism, the researchers used the technology acceptance model, TAM, to examine the effectiveness of the information system. The researchers used the TAM questions due to the excellent reliability and validity results. The evidence of the validity results, of all 12 questionnaire items, was based on the critical value results of the calculated correlation coefficient. This formula suggests the r-count is higher than the r-table. In this research, the r-table is 0.532. The reliability test using Cronbach's alpha yielded an r-count of 0.949, which exceeded the r-table value of 0.532.

The normality tests for diagnostic speed, recommendation speed, and TAM scores produced p-values greater than 0.05, indicating that the data were normally distributed. Therefore, the researchers used an independent t-test to compare the groups. To protect participant confidentiality, the researchers assigned respondent codes and restricted access to participant identities to the researchers and the respective respondents. The Ethics Committee of the Health Polytechnic of the Ministry of Health Semarang approved this study under Ethical Clearance No. 048/EA/KEPK/2021.

RESULTS AND DISCUSSION

Table 1 Respondent Characteristics Based on Educational Background

Educational Background	Intervention n (%)	Control n (%)	*p-value**
Tree Years Diploma of Midwifery	5 (17,9)	4 (14,3)	
Bachelor of Midwifery	6 (21,4)	8 (28,6)	0,459
Professional Midwifery	3 (10,7)	2 (7,1)	

**Lavene's Test*

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Table 1 shows that most respondents in both the intervention and control groups had completed either a tree years diploma or a bachelor's degree in midwifery. This indicates that the respondents in this study met the inclusion criteria, which required a minimum educational background of a tree years diploma. The homogeneity test on the educational background characterictic yielded a significance value of 0,459 (> 0,05), indicating that the data were homogeneous. Therefore, it can be concluded that the distribution of respondent characteristics in both groups was equivalent and comparable in terms of educational background.

This research examined the speed differences among the diagnoses, recommendation, and respondent demands toward the D'PEk_Hil application, a developed application of the previous preeclampsia detection. The current application has 17 risk factors of preeclampsia based on National Guidelines for Medical Services of the Indonesian Obstetrics and Gynecology Association dan Maternal and the 2020 Child Handbook. The current developed application is usefable online to input data of pregnant mother check-up results and to provide diagnoses automatically. Table 2 presents the speed differences to diagnose preeclampsia with D'PEk_Hil application compared to manual system.

Table 2 Diagnosing Speed Differences

Groups	N	Diagnosing speed (second) Mean ±SD	*p-value**	*Effect Size*
Intervention	14	435,46 ± 25,809	0,001	3,6
Control	14	608,11 ± 62,756		

**Independent T-Test*

Table 2 presents all respondents of the intervention group, receiving the developed application, yield average check-up result of 435.46 seconds while the control group with conventional mechanism with 608.11 seconds. The results sugest the intervention group experiences faster speed, 172.65 seconds, than the control group. The independent t-test also proves, with the p-value of 0.001 ≤ 0.05 (α). Thus, the statistic test accepts Ha and denis H0,

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suggesting a time difference between diagnosing preeclampsia with D'PEk_Hil and manual system. The Cohen's d effect size analysis revealed that the implementation of the D'PEk_Hil application had a very large effect (d = 3,6) on the speed of preeclampsia diagnosis. These results indicated that the D'PEk_Hil application substantially improved the speed of diagnosing preeclampsia in pregnant women.

Table 3 provides the required speed differneces to provide recommendation between D'PEk_Hill application and manual system.

Table 3 The Speed Differences to Provide Recommendation

Groups	n	Speed to Recommend (second) Mean ±SD	*p-value**	*Effect Size*
Intervention	14	444,46 ± 25,809	0,000	5,08
Control	14	695,25 ± 62,756		

**Independent T-Test*

Table 3 presents all respondents, within the intervention group, requires average time of 444.46 seconds, to obtain recommendation while the control group with 695.25. The results suggest a relatively faster speed of the intervention group with 250.79 seconds than the control group to receive recommendation of the pregnant women. The independent t-test also obtains a p-value of 0.000 ≤ 0.05 (α). The result accepts Ha and denis H0, suggesting a time difference to provide recommendations for both groups. The Cohen's d effect size analysis revealed that the implementation of the D'PEk_Hil application had a very large effect (d = 5,08) on the speed of providing recommencations. These results indicate that the application substantially improved the speed recommendations regarding preeclampsia symptoms in pregnant women.

The researchers had all respondents of intervention group, using D'PEk_Hil application, to fill the TAM questionnaires. This effort was useful to examine the acceptability and usability of D'PEk-Hil application by midwives. The test also required the researchers to interpret the effectiveness score of the application. Table 4 provides the respondent responses toward D'PEk_Hil application.

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Table 4 Respondent Assessment toward D'PEk_Hil Application

No	Effectiveness of the Variables	n	Min	Max	Mean	(%)
1.	Usefulness	14	4	5	4.6	91.4
2.	Speed	14	4	5	4.5	90
3.	Appropriateness	14	4	5	4.6	91.4
4.	Ease-of-use	14	3	5	4.4	88.6
5.	Accuracy	14	4	5	4.5	90
6.	Trustworthiness	14	4	5	4.6	91.4
Mean			3.8	5	4.5	90.5

Table 4 reveals the usefulness variable, with a maximum score of 5, or "extremely agree," and a minimum score of 4, or "agree." The mean of this variable is 4.6 with a score percentage of 91.4%. The results indicate the application is highly effective for early detection of preeclampsia. In terms of the speed variable, the obtained maximum score from the respondents is 5, "extremely appropriate," and the minimum score is 4, "appropriate." The mean score is 4.5 and the score percentage is 90%. These findings indicate that users considered the application highly effective in facilitating rapid early detection. For the suitability variable, respondents provided a maximum score of 5 (highly appropriate) and a minimum score of 4 (appropriate), resulting in a mean score of 4.6 and a percentage score of 91.4%. These results indicate that users regarded the early detection data generated by the D'PEk_Hil application as highly appropriate.

For the ease-of-use variable, respondents reported a maximum score of 5 (highly appropriate) and a minimum score of 3 (neutral), with a mean score of 4.4 and a percentage score of 88.6%. These findings indicate that users perceived the application as highly effective and easy to use for early detection. For the accuracy variable, respondents assigned a maximum score of 5 (highly appropriate) and a minimum score of 4 (appropriate), producing a mean score of 4.5 and a percentage score of 90%. These results indicate that users considered the application highly effective in providing accurate early detection. For the trustworthiness variable, respondents reported a maximum score of 5 (highly

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appropriate) and a minimum score of 4 (appropriate), with a mean score of 4.6 and a percentage score of 91.4%. These findings indicate that users had a high level of trust in the D'PEk_Hil application.

Overall, Table 4 shows that the six variables achieved a mean score of 4.5, corresponding to an overall effectiveness percentage of 90.5%. The highly effective overall effectiveness score indicates that midwives can readily accept and use the D'PEk_Hil application for the early detection of preeclampsia in pregnant women while obtaining direct feedback from specialist physicians.

Discussion

The D'PEk_Hil application is an expert consulting system that includes a feature enabling direct communication between midwives and specialist physicians through a human-in-the-loop (HiTL) mechanism. In this research, the researchers had specialist physicians provide feedback related to the submitted examination results by the midwives. With the feedback, specialists could evaluate the accuracy of both the generated diagnoses and recommendations from the application to meet the patients' necessities. Among all cases evaluated using the D'PEk_Hil application for early preeclampsia detection, 15 pregnant women received direct feedback from obstetric specialists. Midwives submitted examination results through the application, and specialists reviewed and analyzed the findings. After that, the specialists documented the assessments and the recommendation. They could do it in the advice section. Then, the midwives could access the advice directly through the application.

The D'PEk_Hil application helps midwives establish accurate and timely diagnoses, develop effective care plans, reduce patient waiting times, and minimize administrative workload. (Rahman et al., 2024) also reported that healthcare professionals typically could review patient history, current symptoms, and clinical recommendations. These matters facilitate the determination of relevant diagnoses and treatment plans. Artificial intelligence systems perform similar processes in a much shorter time and often with higher accuracy because they can simultaneously access and analyze

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large volumes of data. In addition, these systems can support healthcare professionals by providing rapid access to relevant clinical information.

In this research, the generated recommendation by the D'PEk_Hil application based on the preeclampsia diagnoses does not immediately replace clinical assessments or diagnoses from either midwives or physicians. Instead, it serves as a data-driven reference that supports clinical decision-making. In this research, the researchers developed an application in which human involvement is essential. These reports require meaningful input from end-users. In the context of healthcare, a human-in-the-loop system is important. This involvement requires safety-critical analysis to be realized within medical practice (Budd et al., 2021). In this framework, humans contribute through evaluation, supervision, and consultation. In terms of implementation, detailed and explicit expert knowledge of clinical processes is important. The evolution of information-based medicine does not neglect the central role of experts to make decisions. This effort occurs by providing patient-specific insights to generate more accurate recommendations (Girardi et al., 2016).

The recommendation system embedded in m-health applications influences the appropriateness of recommendations generated from diagnostic results. However, artificial intelligence (AI) systems do not make predictions with complete certainty because they primarily rely on statistical models rather than absolute certainty. To address this limitation, some AI systems incorporate human-in-the-loop mechanisms that allow experts to provide direct feedback to the system, thereby increasing the reliability and confidence of the resulting recommendations (Wolfewicz, 2020).

The human-in-the-loop could manage the system drawback by participating in the decision process. HITL implementation is a promising technique by integrating knowledge from medical experts, the specialists, into the decision process to ensure the accurate decision and lower system failure while providing recommendation (Holzinger et al., 2016).

The requirement of using the D'PEK_hil application is – medical workforce, the midwives. In this

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research, the midwives had to use online application. In this case, (Manik, 2026) also explains the importances of infrastructures and medical workforce competences in the integrated process of artificial intelligene. Healthcare providers with excellent basic technology conceptual understanding could easily use artificial intelligence to support clinical practices. Thus, training and education about digital technology implementation in providing healthcare service become important to improve the medical workforces' readiness in transforming technological-based health system. This adequate understanding could facilitate medical workers to interpret the generated recommendation by the AI critically and contextually.

Implementation of D'PEk_Hil Application in Predicting Preeclampsia based on Preeclampsia Risk Factors

The D'PEk_Hil application is an innovation developed from the previous Preeclampsia Detection application by incorporating a comprehensive preeclampsia risk-factor screening checklist, which was absent in the earlier version. The application operates as smartphone-based software designed to support the early detection of preeclampsia. It aims to accelerate risk assessment during early pregnancy and facilitate the management of pregnant women identified with hypertensive disorders of pregnancy. In addition, the D'PEk_Hil application enables users to obtain direct feedback from specialists.

Healthcare providers can use smartphone-based applications to perform early preeclampsia screening based on maternal risk factors, with accuracy levels that closely align with expert diagnoses (Trayner, 2017). Therefore, early detection applications can serve as an effective tool for midwives to identify preeclampsia in pregnant women (Ahmad M, 2018).

The statistical analysis showed that the intervention group using the D'PEk_Hil application required an average of 435.46 seconds to complete preeclampsia detection, with a standard deviation of 25.809. Contradictorily, the time average needed by the control group is 608.11 seconds, with an SD of 62.756. These findings suggest the developed application could lower the required time for early preeclampsia detection by 172.79 compared with the manual method. Thus, the application

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increased the speed of diagnosis by automatically analyzing preeclampsia risk factors and patient data entered into the system, whereas the manual approach relied on the Mother and Child Health Handbook.

The substantial difference in detection time between the D'PEk_Hil application and the manual method resulted from the number of calculations required in the conventional process. When using the manual approach, midwives had to calculate body mass index (BMI), determine mean arterial pressure (MAP), score preeclampsia risk factors, and complete a preeclampsia screening assessment. In contrast, when using the D'PEk_Hil application, midwives only needed to enter the pregnant woman's data into the system. The application then automatically processed the information and determined whether the woman was at risk of preeclampsia while simultaneously generating a current health assessment.

According to (Idris et al., 2025), healthcare information systems positively affect diagnostic accuracy, efficiency, and speed. These systems facilitate early disease detection, reduce diagnostic errors, and support more personalized, data-driven treatment strategies. Early preeclampsia detection systems also improve the completeness of maternal data used for screening and diagnosis compared with manual methods (Aini et al., 2019). Another study reported that approximately seven million individuals remained undiagnosed with hypertension and were unaware of their hypertension risk factors. Timely and accurate early detection of hypertension produces better outcomes than identifying the condition only after hypertension has developed (Trayner & Taylor, 2017). These findings highlight the importance of early preeclampsia screening during pregnancy to ensure timely intervention and management.

Persistent errors found in preeclampsia diagnosis may occur due to incomplete examination data. This matter indicates the inadequacy of applied informationn to support diagnosis and monitor maternal health (Espinilla et al., 2017). Early detection of preeclampsia enables healthcare providers to establish appropriate monitoring plans and clinical management strategies after identifying

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complications at an early stage. Prophylactic interventions initiated during mid-pregnancy may be less effective, whereas predicting preeclampsia in early pregnancy can facilitate more effective preventive strategies. Therefore, comprehensive examination data are essential for identifying preeclampsia risk factors early, preventing disease progression, and reducing adverse maternal outcomes.

Implementation of D'PEk_Hil in Providing Therapy Recommendation

The D'PEk_Hil application is a system that automatically generates recommendations based on diagnostic results and identified risk factors. The developers designed the recommendation module according to the National Guidelines for Medical Services of the Indonesian Obstetrics and Gynecology Association and integrated specialist physicians' evaluations to produce recommendations that healthcare providers can directly implement in the management of pregnant women.

Statistical analysis showed that the intervention group using the D'PEk_Hil application required an average of 444.46 seconds to generate recommendations, with a standard deviation of 25.809. In contrast, the control group required an average of 695.25 seconds, with a standard deviation of 62.756. Thus, the intervention group generated recommendations 250.79 seconds faster than the control group. Statistical testing confirmed that the difference in recommendation time between the D'PEk_Hil application and the manual method was significant.

The substantial difference in recommendation time resulted from the additional analysis required in the manual process. When using the conventional method, midwives needed to reanalyze examination findings before determining an appropriate therapeutic recommendation based on the pregnant woman's current condition. Furthermore, the midwives' experience and educational background influenced the time required to formulate recommendations. In contrast, the D'PEk_Hil application automatically generates recommendations based on early preeclampsia detection results and risk-factor screening data stored within

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the system.

The recommendation output provided by the application facilitates healthcare providers' work, particularly that of midwives, by supporting the delivery of appropriate care to pregnant women. In addition, the recommendation feature helps reduce errors in diagnosis and clinical management for both healthy pregnant women and those at risk of complications.

Previous studies have shown that application-based recommendation systems are necessary to ensure that generated outputs remain consistent with the clinical information and diagnoses entered into the system, thereby improving recommendation accuracy (Simbolon et al., 2020). Recommendation systems also help prevent errors in clinical decision-making and improve the effectiveness of selecting appropriate interventions (Yang et al., 2017).

The recommendation system embedded in the application assists users in making decisions based on collected and classified patient data. This system could generate recommendations for the users' necessities by using the knowledge base (Alian et al., 2018). Recommendation systems can also support accurate diagnosis and predict appropriate medication strategies. The reports from the Centers for Disease Control and Prevention found that more than 250,000 deaths were attributed to medication errors. To address this issue, recommendation systems integrate expert medical knowledge with bidirectional long short-term memory (LSTM) models to generate effective time-sequenced recommendations for long-term health conditions. This approach enables healthcare providers to monitor treatment histories more effectively over extended periods (Wedagu et al., 2020).

Effectiveness of D'PEk_Hil Application by Medical Workers

The effectiveness evaluation of the D'PEk_Hil application produced a mean score of 4.4 (88.6%) across six dimensions: usefulness, speed, suitability, ease of use, accuracy, and trust. These results indicate that the D'PEk_Hil application is highly effective for the early detection of preeclampsia. Technology adoption

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generally depends on cognitive processes and aims to maximize the utility of the technology. System quality, self-efficacy, and perceived ease of use positively influence users' intentions to adopt information systems in the future (Salloum et al., 2019).

One strategy for promoting the adoption of m-health applications is to prioritize ease of use while ensuring the confidentiality of patient data and examination results. Research has shown that concerns about data privacy can influence the use of m-health applications. Furthermore, perceived usefulness predicts users' intentions to adopt m-health services more strongly than perceived ease of use. Device design also plays an important role in user acceptance of a system (Campbell et al., 2017).

M-health applications not only accelerate data entry but also stimulate demand for essential health services, strengthen human resource capacity, and improve the overall performance of healthcare systems. As a result, m-health solutions increase the efficiency of healthcare delivery (Negandhi et al., 2016). They also reduce operational costs because healthcare providers no longer rely on paper-based data collection methods and can collect data more efficiently (Rothstein et al., 2016).

The implementation of m-health systems in maternal health data collection and reporting provides several benefits. These systems could improve data quality by improving completeness; timeliness through real-time reporting; currency; and accuracy. Those systems also facilitate efficient data collection, simplify supervision and monitoring, improve healthcare service quality, improve workforce productivity, motivate healthcare workers, lower workload in terms of data collection and utilization, and facilitate rapid data synthesis within a user-friendly format (Hermansyah et al., 2017; Permatasari et al., 2021).

Information systems also streamline patient registration, accelerate access to existing patient records, and facilitate the storage of large volumes of data. In addition, they improve reporting processes, enhance data security and maintenance, and reduce the risk of duplicate medical record numbers (Permatasari et al., 2021).

The D'PEk_Hil application

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represents an innovative approach to early pre-eclampsia detection. Before this study, no dedicated preeclampsia screening application incorporated a human-in-the-loop feature. By following the standards established by the National Institute for Health and Clinical Excellence (NICE) and the National Guidelines for Medical Services of the Indonesian Obstetrics and Gynecology Association, the application captures more comprehensive information on pregnant women, including risk factors and examination findings relevant to preeclampsia screening. The integration of automated recommendations and direct expert feedback further enhances the application's effectiveness and practical value in supporting midwives' daily clinical responsibilities.

The researchers acknowledge several limitations of this study. The limited study period restricted the number of pregnant women with preeclampsia risk factors who could be included in the dataset. Future versions of the application should incorporate a direct chat feature with specialist physicians to facilitate faster feedback and allow users to determine physician availability in real time. The application also requires a stable internet connection to ensure optimal performance. In addition, the D'PEk_Hil application currently supports only Android-based smartphones, preventing access by users of other mobile operating systems.

CONCLUSIONS

The current results and discussions conclude the developed application could early detect based on the preeclampsia factors and immediate recommendation speed than the manual system. The D'PEk_Hil application had excellent capability to perform human-in-the-loop feature to provide immediate feedback from the specialists. The effectiveness of the application, by the midwives, is high with a percentage of 90.5%. Thus, D'PEk_Hill could facilitate midwives to perform early preeclampsia detection and receive immediate feedback from the experts remotely.

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